

SEQUENCE LISTING

<110> Celentis Limited
AgResearch Limited

<120> Indole-Diterpene Biosynthesis

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<140> NZ 530331

<141> 2003-12-22

<160> 51

<170> PatentIn version 3.3

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<212> DNA

<213> Neotyphodium lolii

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<213> Neotyphodium lolii

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Ala Leu Pro Ser Lys Asp Ile Arg Ser Gly Leu Thr Asp Ala Ile Asn
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Glu Phe Leu Arg Val Pro Glu Glu Lys Val Leu Val Ile Lys Arg Ile
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Ile Asp Leu Leu His Asn Ala Ser Leu Leu Ile Asp Asp Ile Gln Asp
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Ser Ser Lys Leu Arg Arg Gly Val Pro Val Ala His His Ile Phe Gly
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Ile Ala Gln Thr Ile Asn Ser Ala Asn Leu Ala Tyr Phe Ile Ala Gln
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Arg Glu Leu Glu Lys Leu Thr Asn Pro Arg Ala Phe Ala Ile Tyr Asn
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Arg Glu Ser Leu His Cys Pro Thr Glu Asp Glu Tyr Leu Arg Met Ile
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Gln Lys Lys Thr Gly Gly Leu Phe Arg Leu Ala Ile Arg Leu Leu Gln
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Gly Glu Ser Ala Ser Asp Asp Asp Tyr Val Ser Leu Ile Asp Thr Leu
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Gly Thr Leu Phe Gln Ile Arg Asp Asp Tyr Gln Asn Leu Gln Ser Asp
 210 215 220

Ile Tyr Ser Lys Asn Lys Gly Tyr Cys Glu Asp Leu Thr Glu Gly Lys
 225 230 235 240

Phe Ser Tyr Pro Val Ile His Ser Ile Arg Ser Arg Pro Gly Asp Val
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Arg Leu Ile Asn Ile Leu Lys Gln Arg Ser Glu Asp Val Met Val Lys
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Gln Tyr Ala Val Gln His Ile Glu Ser Thr Gly Ser Phe Ala Phe Cys
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Gln Asn Lys Ile Gln Ser Leu Val Glu Gln Ala Arg Glu Gln Leu Ala
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 Ile Leu Pro Asn Gly Gly Arg Ile Leu Asp Gln Leu Gly Ile Phe His
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 Ser Ile Glu Asp Glu Ile Glu Pro Leu Glu Ser Ala Met Met Arg Tyr
 65 70 75 80
 Pro Asp Gly Phe Ser Phe Lys Ser Gln Tyr Pro Gln Ala Leu His Thr
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 Ser Phe Gly Tyr Pro Val Ala Phe Leu Glu Arg Gln Arg Phe Leu Gln
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Ser Asp Gly Ala Lys Tyr Leu Ala Asp Ile Val Ile Gly Ala Asp Gly
 145 150 155 160

Val His Ser Ile Val Arg Ser Glu Ile Trp Arg His Leu Lys Glu Asn
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Ser Gln Ile Ser Val Leu Glu Ala Pro Asn Ala Ser Ile Lys His Asp
 180 185 190

Tyr Ser Cys Ile Tyr Gly Ile Ser Leu Asn Val Pro Gln Ile Ile Leu
 195 200 205

Gly Ile Gln Leu Asn Cys Leu Asp Asp Gly Val Ser Ile His Leu Phe
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Thr Gly Lys Gln Ser Lys Leu Phe Trp Phe Val Ile Ile Lys Thr Pro
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Gln Ala Ser Phe Ala Lys Val Glu Ile Asp Asn Thr His Thr Ala Arg
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Phe Glu Asp Val Trp Ser Arg Cys Thr Ile Phe Lys Met Thr Pro Leu
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Glu Glu Gly Val Phe Lys His Trp Asn Tyr Gly Arg Leu Ala Cys Ile
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Gly Asp Ala Ile Arg Lys Met Ala Pro Asn Asn Gly Gln Gly Ala Asn
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Met Ala Ile Glu Asp Ala Cys Ser Leu Ala Asn Ile Leu Gln Lys Lys
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Ile Ser His Gly Ser Ile Arg Asp Gln Asp Ile Asn Ser Met Phe Gln
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Glu Phe Ser Met Ala Gln Arg Ala Arg Thr Glu Ser Val Cys Ala Gln
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Leu Ser Gly Phe Ser Ile Ser Gly Ala Thr Arg Ile Glu Phe Ile Asp
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Ser Trp Glu Phe Ile Leu Gln Ser Leu Val Tyr Leu Arg Pro Lys Phe
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Ile Val Ala Leu Leu Val Leu Ile Val Cys Ile Phe Leu Tyr Trp Arg
 35 40 45

Thr Pro Thr Gly Ile Asn Ala Pro Phe Ala Gly Tyr Arg Ser Pro Trp
 50 55 60

Glu Pro Pro Leu Leu Val Gln Met Arg Tyr Val Phe Asn Ala Ala Ser
 65 70 75 80

Met Ile Arg Glu Gly Tyr Ala Lys Trp Lys Asp Ser Leu Phe Gln Ile

Ser Arg Tyr Asp Gly Asp Ile Leu Ile Val Pro Pro Arg Tyr Leu Asp
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Asp Leu His Asn Lys Ser Gln Glu Glu Leu Ser Ala Ile Tyr Gly Leu
 115 120 125

Ile Arg Asn Phe Gly Gly Ser Tyr Ser Gly Ile Thr Leu Leu Gly Glu
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Asn Asp Val Gly Ile Arg Ala Leu Gln Thr Lys Ile Thr Pro Asn Leu
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Ala Lys Leu Cys Asp Asp Ile Arg Asp Glu Phe Gln Tyr Cys Leu Asp
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Thr Asp Phe Pro Ala Cys Arg Asp Trp Thr Ser Val Ser Val His Pro
 180 185 190

Leu Phe Leu Lys Ala Val Glu Arg Ile Thr His Arg Ile Phe Val Gly
 195 200 205

Leu Pro Leu Cys Arg Asn Pro Gln Trp Val Gln Ala Thr Ser Lys His
 210 215 220

Ala His Tyr Ala Thr Met Ile Gln Ile Ala Met Arg Ser Val Pro Lys
 225 230 235 240

Phe Ile Gln Pro Leu Leu Asn Phe Cys Leu Pro Trp Pro Trp Lys Asn
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Ala Ala Cys Val Arg Glu Ala Lys Asn Ala Leu Ile Leu Glu Met Gln
 260 265 270

Arg Arg Arg Asn Leu Glu Lys Val Asn Ser Phe Asp Tyr Ile Lys Ser
 275 280 285

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Asp Ser Gln Leu Asp Val Val Ala Gln Ile Met Leu Thr Met Asn Thr
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Ile Ala Gly His Ser Thr Ala Ala Ser Gly Ala His Ala Leu Phe Asp
 325 330 335

Met Val Ser His Ser Lys Tyr Ile Glu Leu Leu Arg Glu Glu Ala Leu

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345

350

Gln Val Phe Arg His Val Glu Leu Arg Val Thr Lys Gln Ala Leu Gly
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Asp Leu Arg Lys Leu Asp Ser Phe Leu Arg Glu Ser Gln Arg His Asn
 370 375 380

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 385 390 395 400

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 405 410 415

Val Ala Pro His Ala Ile Ser Asn Asp Pro Asp Val Ile Glu Asp Pro
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Thr Ser Phe Asn Gly Leu Arg Tyr Tyr Glu Gln Arg Cys Arg Asp Ala
 435 440 445

Ser Gln Glu Lys Lys His Gln Tyr Ala Thr Thr Asp Lys Ser His Leu
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His Phe Gly Tyr Gly Thr Trp Ala Cys Pro Gly Arg Phe Leu Ala Ser
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Asp Met Leu Lys Val Ile Leu Thr Met Leu Leu Leu Gln Tyr Asp Ile
 485 490 495

Arg Ser Pro Glu Arg Ala Lys Arg Pro Val Ala Gly His Phe His Glu
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<213> *Neotyphodium lolii*

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Gly Tyr Glu Arg Thr Ser His Glu Gly Ile Gly Gly Ser Asn Gly Lys
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Ile Pro Asp Cys Pro Tyr Ser Tyr Val Ile Ser Leu Tyr Gly His Asn
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Tyr Pro Lys Lys His Ser Leu Ile Leu Asp Ile Met Asp Ala Val His
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Leu Cys Leu Ile Met Val Asp Asp Ile Cys Asp His Ser Pro Lys Arg
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Leu Glu Gly Gln Asp Met Ser Leu Val Trp Arg Arg Asp Gly Leu Arg
 180 185 190

Ser Phe Glu Ser Tyr Gly Glu Glu Ser Leu Leu Thr Tyr Lys Asn Met
 195 200 205

Ala Leu Leu Lys Thr Gly Thr Leu Phe Val Leu Leu Gly Arg Leu Leu
 210 215 220

Asn Gln Gly Gly His Gln Ser Asp Asp Leu Leu Gly Arg Phe Gly Trp
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Tyr Ala Gln Leu Gln Asn Asp Cys Lys Asn Ile Tyr Ser Glu Glu Tyr
 245 250 255

Ala Phe Asn Lys Gly Thr Val Ala Glu Asp Leu Arg Asn Arg Glu Leu
 260 265 270

Ser Phe Pro Val Val Val Ala Leu Asn Asp Lys His Thr Glu Pro Gln
 275 280 285

Ile Arg Lys Ala Phe Gln Ser Gln Asn Gln Gly Asp Ile Lys Arg Ala
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Leu Gln Ala Leu Glu Ser Pro Ser Val Lys Asn Thr Cys Leu Lys Thr
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Met Leu Met Leu His Ala Val Pro Val Gly Ile Cys Leu Leu Leu Trp
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Tyr Val Val Tyr Gly Thr Lys Arg Lys Glu Cys Ile Pro Thr Ile Arg
 20 25 30

Arg Trp Pro Arg Leu Leu Pro Gln Phe Leu Asp Arg Leu Ser Tyr Asn
 35 40 45

Asp His Ala Ala Arg Leu Val Lys His Gly Tyr Glu Lys His Lys Asn
 50 55 60

Gln Pro Phe Arg Leu Leu Lys Met Asp Met Asp Leu Ile Val Ile Pro
 65 70 75 80

Leu Gln Tyr Ala Leu Glu Leu Arg Ala Val Thr Ser Asp Lys Leu Asp
 85 90 95

Pro Leu Thr Ala Ser Phe Asp Asp Asn Ala Gly Lys Val Thr Arg Ile
 100 105 110

Leu Leu Gly Ser Glu Leu His Thr Arg Ala Ile Gln Gln Arg Leu Thr
 115 120 125

Pro Lys Leu Pro Gln Thr Leu Pro Val Leu Leu Asp Glu Leu Asn His
 130 135 140

Ala Phe Gly Gln Val Leu Pro Ala Gly Asn Asp Gly Ser Asn Ala Trp
 145 150 155 160

Ile Ser Val Asn Pro Tyr Glu Leu Val Leu Asn Leu Ala Thr Arg Ala
 165 170 175

Thr Ala Arg Leu Phe Val Gly Asp Leu Ile Cys Arg Asn Glu Ile Phe
 180 185 190

Leu Glu Thr Thr Ala Ser Phe Ser Arg Asn Thr Phe Asp Thr Ile Ser
 195 200 205

Thr Ser Arg Ser Phe Gly Asn Leu Phe Thr His Tyr Phe Ala Arg Trp
 210 215 220

Ile Ser Thr Ala Lys Glu Ala His Gly Gln Leu Gln Tyr Ile Gln Asn
 225 230 235 240

Leu Leu Gly Ser Glu Val Gln Arg Arg Lys Leu Asn Ser Glu Glu Lys
 245 250 255

His Asp Asp Phe Leu Gln Trp Cys Thr Glu Leu Ala Val Thr Glu Asp
 260 265 270

Glu Ala Arg Pro Glu Ala Leu Ala His Arg Thr Leu Gly Ile Leu Ser
 275 280 285

Met Ala Val Ile His Thr Thr Ala Met Ala Leu Thr His Ile Leu Phe
 290 295 300

Asp Met Ile Ser Asp Asp Ser Leu Lys Glu Ser Leu Arg Arg Glu Gln
 305 310 315 320

Gln Asn Val Leu Lys His Gly Trp Thr Glu Ile Thr Gln Gln Thr Met
 325 330 335

Leu Asp Met Lys Gln Leu Asp Ser Leu Met Arg Glu Ser Gln Arg Ile
 340 345 350

Asn Pro Val Gly Glu Phe Thr Phe Arg Arg Ile Val Arg Glu Arg Ile
 355 360 365

Thr Leu Ser Asp Gly Tyr Gln Leu Gln Pro Gly Gln Gln Ile Ala Ile
 370 375 380

Pro Ala Lys Cys Ile Asn Thr Asp Ser Thr Lys Leu Ser Asp Ala His
 385 390 395 400

Leu Phe Gln Pro Phe Arg Trp Leu Lys Gln Ser Gly Thr Ala Thr Thr
 405 410 415

Ser Phe Ser Asn Ser Ser Ala Leu Asn Leu His Phe Gly Phe Gly Arg
 420 425 430

Tyr Ala Cys Pro Gly Arg Phe Ile Ala Ser Tyr Met Ile Lys Ala Ile
 435 440 445

Met Ser Arg Ile Leu Leu Glu Tyr Asp Phe Lys Leu Asp Ser Glu Phe
 450 455 460

Pro Ser Arg Arg Pro Pro Asn Ile Val His Gly Asp Lys Ile Leu Pro
 465 470 475 480

Asn Arg Asn Ala Val Val Leu Leu Arg Arg Leu Glu Lys Thr Val Thr
 485 490 495

Val Cys

<210> 11
 <211> 1945
 <212> DNA
 <213> Neotyphodium lolii

<400> 11
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 cctgggaatg gggaaatgcg cgctccgttt gttggttata gctggccatt cgagcctact 180
 ttctgggtcc gaatgcgctt catctttcag agtttaggca tgatgaccga aggataactca 240
 aaggtgagct cccgtccggg tggagaaaga cagctagacg aatgactgac gccaaacgct 300
 tgacagttca aggattccat gttcaagata acgaccaacg atgccgactg gcttgctctc 360
 tcccaacgct acttggaatga cttgcagtct ctgccagccg agagattgag ccatacagac 420
 gctctagtga cggtaggggc gcatactagt cgctagtccc tacgacagtg gtgtgctaata 480
 cgagtttgtt ctcatttaga tgtgggggag cagccacagc ccttttgctc tgctcaacaa 540
 gagtgatctt agctctcgag ctcttcgtgt aaggaccaat ccctccttgt tatgcagaac 600
 ggatctgact tgaaaaggac gtggttgccg cgaattatgc caaggacctt gatagcctcg 660
 tagacgaact ccgctattcg cttgagcacg atatagacat acaggatggt atgtatgcgc 720
 ctattttcca actaattttg aggtcgctcat gttggctgac tgggtcgatg cgcttagact 780
 ggaaaccgat tgatgccctt gaactttctt cgaagttggt gttgcggata tcgcagcgaa 840
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 cagacgctgg taagaggacg agctgttacg tatgaccctt ttcttcggtt aaaactaacg 960
 ggggtttcag ctaccgtcgt ccagtttgcc ctgaaactac ttcttcgcca gattcggccg 1020
 cttgtctata ctctgctccc acaagcatgg gctactaaat cgtggatcag gcgctgtgac 1080
 aagatactgg caaaggaaat gcaacgtcga caagttttgg agaagtcgga tcccgtgtac 1140
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 aaacttgac atgattttct cgtccaagcc ttgatttcca gaatggctcc agttgttacc 1260
 atggcccaaa cccttggtga tcttgccctc catcctgagg atatcgagga gctgcgtgat 1320
 gaggttctgc aagtcatagg accagacggg gcgggattag gaaacctacg acaatcattt 1380

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accaaaacttg acaagatgga cagcgtcttg agggaatctg ccagggtcac ccctctatct 1440
atgagtaagt gccatttctg tcttcagaa tagcttgctg gcatgactaa tctgtggtat 1500
agtgacaatg caccgccggg ttcaggacgc caagggcatc acgctccatg acggtgtgca 1560
tcttcacga ggcacgcatg tggcattccc agcgtaccac attggcagag atcccaagtt 1620
ggtgtcaggt gcagatatct atgacgggct gcgctggtac aggaaggacc tcggcgaggc 1680
ccaagaaaac gaagctccca agcatcgatt tgtcaccccc gacagcaact acttgacctt 1740
tgggtccggt aaatacgtct gccccggccg atttatagcg gaacacatgt tgaagctgat 1800
gatgaccgcc gtgctcctgc gctacgagtt caagtggcct ccgggagtcc ctgtgccga 1860
acaacagtat cggcatgtct ttgcttatcc aagcaaaacc aactgttga ttaaacgacg 1920
caaagatggc gatcagattc tttaa 1945

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<210> 12
<211> 525
<212> PRT
<213> Neotyphodium lolii

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<400> 12

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Met Ala Phe Ala Ser Leu Leu His His Ile Trp Asn His Ala Val Asp
1          5          10          15

```

```

Cys Ala Glu Gln Leu Thr Trp Trp Gln Thr Ile Val Ser Phe Ile Ile
      20          25          30

```

```

Phe Cys Ile Met Cys Ser Trp Leu Pro Gly Asn Gly Glu Met Arg Ala
      35          40          45

```

```

Pro Phe Val Gly Tyr Arg Trp Pro Phe Glu Pro Thr Phe Trp Val Arg
50          55          60

```

```

Met Arg Phe Ile Phe Gln Ser Leu Gly Met Met Thr Glu Gly Tyr Ser
65          70          75          80

```

```

Lys Phe Lys Asp Ser Met Phe Lys Ile Thr Thr Asn Asp Ala Asp Trp
      85          90          95

```

```

Leu Val Leu Ser Gln Arg Tyr Leu Asp Asp Leu Gln Ser Leu Pro Ala
100          105          110

```

```

Glu Arg Leu Ser His Thr Asp Ala Leu Val Thr Met Trp Gly Ser Ser
115          120          125

```

```

His Ser Pro Phe Ala Leu Leu Asn Lys Ser Asp Leu Ser Ser Arg Ala
130          135          140

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Leu Arg Asp Val Val Ala Pro Asn Tyr Ala Lys Asp Leu Asp Ser Leu
 145 150 155 160
 Val Asp Glu Leu Arg Tyr Ser Leu Glu His Asp Ile Asp Ile Gln Asp
 165 170 175
 Asp Trp Lys Pro Ile Asp Ala Leu Glu Leu Ser Ser Lys Leu Val Leu
 180 185 190
 Arg Ile Ser Gln Arg Ile Leu Ile Gly Trp Pro Met Ser Arg Asp Gln
 195 200 205
 Glu Leu Leu Glu Cys Ala Gln Gly Tyr Ala Asp Ala Ala Thr Val Val
 210 215 220
 Gln Phe Ala Leu Lys Leu Leu Pro Arg Gln Ile Arg Pro Leu Val Tyr
 225 230 235 240
 Pro Leu Leu Pro Gln Ala Trp Ala Thr Lys Ser Trp Ile Arg Arg Cys
 245 250 255
 Asp Lys Ile Leu Ala Lys Glu Met Gln Arg Arg Gln Val Leu Glu Lys
 260 265 270
 Ser Asp Pro Val Tyr Glu Lys Pro Lys Asp Leu Leu Gln Gly Met Val
 275 280 285
 Asp Leu Glu Pro Ser Arg Pro Val Asp Lys Leu Gly His Asp Phe Leu
 290 295 300
 Val Gln Ala Leu Ile Ser Arg Met Ala Pro Val Val Thr Met Ala Gln
 305 310 315 320
 Thr Leu Val Asp Leu Ala Leu His Pro Glu Asp Ile Glu Glu Leu Arg
 325 330 335
 Asp Glu Val Leu Gln Val Ile Gly Pro Asp Gly Ala Gly Leu Gly Asn
 340 345 350
 Leu Arg Gln Ser Phe Thr Lys Leu Asp Lys Met Asp Ser Val Leu Arg
 355 360 365
 Glu Ser Ala Arg Phe Thr Pro Leu Ser Met Met Thr Met His Arg Arg
 370 375 380
 Val Gln Asp Ala Lys Gly Ile Thr Leu His Asp Gly Val His Leu Pro
 385 390 395 400

Arg Gly Thr His Val Ala Phe Pro Ala Tyr His Ile Gly Arg Asp Pro
 405 410 415

Lys Leu Val Ser Gly Ala Asp Ile Tyr Asp Gly Leu Arg Trp Tyr Arg
 420 425 430

Lys Asp Leu Gly Glu Ala Gln Glu Asn Glu Ala Pro Lys His Arg Phe
 435 440 445

Val Thr Pro Asp Ser Asn Tyr Leu Thr Phe Gly Ser Gly Lys Tyr Val
 450 455 460

Cys Pro Gly Arg Phe Ile Ala Glu His Met Leu Lys Leu Met Met Thr
 465 470 475 480

Ala Val Leu Leu Arg Tyr Glu Phe Lys Trp Pro Pro Gly Val Pro Val
 485 490 495

Pro Glu Gln Gln Tyr Arg His Val Phe Ala Tyr Pro Ser Lys Thr Thr
 500 505 510

Leu Leu Ile Lys Arg Arg Lys Asp Gly Asp Gln Ile Leu
 515 520 525

<210> 13
 <211> 2014
 <212> DNA
 <213> *Neotyphodium lolii*

<400> 13
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 tgaatctgtt tcccttgcta tgcacttttc ttggatgctc accaaaattt ttcaaggtga 180
 atgtacctgt tgttggcatt ggagttcgat atacaaaatg gctagcggct attataaacg 240
 tgcgtcatgc tcgacaatct atccgcgagg gctatgcaaa ggtttgtgtt aaaaacgaat 300
 aaaagcgctt cgtaaacaaa gagaactaat actagtttct agtatggcga tttcgcgttt 360
 cagataccta ctatgactcg aatggaggta ttcatttgtg atagacagat gacaaggagg 420
 tatcagaatg ttgacgacta tcatttgtcg ttccgagctg tcatgaccga ggtaagtaac 480
 tagaccatgt taactgtagg aaaagaagaa aaagctaaac cgccgtacag gagtttcaat 540
 tcaaatggct acttccagga caggcacacg aagcccggat tatccctaac tcagtgtattg 600
 ctaaggcctt gagctggcag agaacaaggg cgaataaacc cagcgatcca ttcttcgaat 660
 ctttctccgc cgaattcatg caggggtttc aggaagagat gcgacgacta atccaatatc 720

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aaaattcgtc agttatgtca aacogctccg gtgctgtcct ggatccagcg catggttggc 780
atgctgtgcc ttgttttccc ttggctctga aggtaattgg gcgccttact acatacgtct 840
tgttcggcaa acctttgtgc caagatgcga cattcctaaa catgtgctgt caatttggcg 900
atgtgattcc cagggatgcg atcatactac gttcatggcc agcattggca aggccgtaag 960
caagtgccta gacataaacc cgtcagggtt taaactcgca ttaacattca tatagtctta 1020
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agataaagag caggagagaa tcccacgaaa cgaacccaat gagtgtatgg ctgtctcgca 1140
caccctctct agcattacac attaacgtat atctaggata tcttggattt cacaatggcc 1200
tggttgacc gtcaccta cgtagcttt gacgatcagc acattgccga gatgatgatt 1260
aacactatct tcgcagctct tcatacgtcg agtcaggat attttttct gtatgaaaag 1320
tccagagctt aaagctaact ggctcatagc tgggtgtgca taccatcttt gagcttgctt 1380
cacgtcctga atatagcgat gcgcttctgg aagagataga tgcattgctt gaaaagcatg 1440
gaaagggcac taaagcagct ctagactcaa tgttcaaggt ggatagtctt atcaaagaaa 1500
cgcagaggtt taacctctt gacgatgta taaattccct gtctccgatt ccatcattgc 1560
gatttgacta acgccaccgt cagcogctct tgcaagactg gctctcaaag actttacttt 1620
ttccaatggc ctaaaccatcc caaagggcag tgtgattttc acgccgaatt cgctatctt 1680
tgaggacgag agatattaca aggatccgaa agtttttgat ggatttcggt ttgctaggat 1740
gcgtaatgac ccaaaattag gtctattctg cgacctaaac gcaacgaatg aacaaagcat 1800
gcattttggg actggacgtc acgcctgtcc tggtagattt atggtttctg atgaggtcaa 1860
gttagctgtg attcatatct taagtaattt cgatttttgt attgagaatt ttggaccacg 1920
gccagcaaat cagccatttg gtaaatttct tctacctgat atgagtgcaa aaatctggct 1980
aaggagaaaa agagctaggg agaagaatct gtga 2014

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<210> 14

<211> 537

<212> PRT

<213> Neotyphodium lolii

<400> 14

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Met Lys Met Leu Thr Glu His Phe Asp Phe Pro Lys Leu Asn Phe Ala
1           5           10          15

```

```

Thr Ile Val Ile Ser Gly Ala Thr Ile Ile Gly Ile Ile Phe Leu Arg
          20          25          30

```

```

Tyr Leu Asn Tyr Pro Thr Lys Val Asn Val Pro Val Val Gly Ile Gly
          35          40          45

```

Val Arg Tyr Thr Lys Trp Leu Ala Ala Ile Ile Asn Val Arg His Ala
 50 55 60

Arg Gln Ser Ile Arg Glu Gly Tyr Ala Lys Tyr Gly Asp Phe Ala Phe
 65 70 75 80

Gln Ile Pro Thr Met Thr Arg Met Glu Val Phe Ile Cys Asp Arg Gln
 85 90 95

Met Thr Arg Glu Tyr Gln Asn Val Asp Asp Tyr His Leu Ser Phe Arg
 100 105 110

Ala Val Met Thr Glu Glu Phe Gln Phe Lys Trp Leu Leu Pro Gly Gln
 115 120 125

Ala His Glu Ala Arg Ile Ile Pro Asn Ser Val Ile Ala Lys Ala Leu
 130 135 140

Ser Trp Gln Arg Thr Arg Ala Asn Lys Pro Ser Asp Pro Phe Phe Glu
 145 150 155 160

Ser Phe Ser Ala Glu Phe Met Gln Gly Phe Gln Glu Glu Met Arg Arg
 165 170 175

Leu Ile Gln Tyr Gln Asn Ser Ser Val Met Ser Asn Arg Ser Gly Ala
 180 185 190

Val Leu Asp Pro Ala His Gly Trp His Ala Val Pro Cys Phe Pro Leu
 195 200 205

Ala Leu Lys Val Ile Gly Arg Leu Thr Thr Tyr Val Leu Phe Gly Lys
 210 215 220

Pro Leu Cys Gln Asp Ala Thr Phe Leu Asn Met Cys Cys Gln Phe Gly
 225 230 235 240

Asp Val Ile Pro Arg Asp Ala Ile Ile Leu Arg Ser Trp Pro Ala Leu
 245 250 255

Ala Arg Pro Leu Ile Val Lys Ile Leu Ser Ala Pro Arg Val Met Gly
 260 265 270

Lys Leu Arg Asn Ile Leu Ile Val Glu Ile Lys Ser Arg Arg Glu Ser
 275 280 285

His Glu Thr Asn Pro Met Ser Asp Ile Leu Asp Phe Thr Met Ala Trp
 290 295 300

Val Asp Arg His Pro Asn Ala Ser Phe Asp Asp Gln His Ile Ala Glu
 305 310 315 320

Met Met Ile Asn Thr Ile Phe Ala Ala Leu His Thr Ser Ser Gln Leu
 325 330 335

Val Val His Thr Ile Phe Glu Leu Ala Ser Arg Pro Glu Tyr Ser Asp
 340 345 350

Ala Leu Leu Glu Glu Ile Asp Ala Cys Phe Glu Lys His Gly Lys Gly
 355 360 365

Thr Lys Ala Ala Leu Asp Ser Met Phe Lys Val Asp Ser Phe Ile Lys
 370 375 380

Glu Thr Gln Arg Phe Asn Pro Leu Asp Ala Ser Ala Leu Ala Arg Leu
 385 390 395 400

Ala Leu Lys Asp Phe Thr Phe Ser Asn Gly Leu Asn Ile Pro Lys Gly
 405 410 415

Ser Val Ile Phe Thr Pro Asn Ser Pro Ile Phe Glu Asp Glu Arg Tyr
 420 425 430

Tyr Lys Asp Pro Lys Val Phe Asp Gly Phe Arg Phe Ala Arg Met Arg
 435 440 445

Asn Asp Pro Lys Leu Gly Leu Phe Cys Asp Leu Thr Ala Thr Asn Glu
 450 455 460

Gln Ser Met His Phe Gly Thr Gly Arg His Ala Cys Pro Gly Arg Phe
 465 470 475 480

Met Val Ser Asp Glu Val Lys Leu Ala Val Ile His Ile Leu Ser Asn
 485 490 495

Phe Asp Phe Cys Ile Glu Asn Phe Gly Pro Arg Pro Ala Asn Gln Pro
 500 505 510

Phe Gly Lys Phe Leu Leu Pro Asp Met Ser Ala Lys Ile Trp Leu Arg
 515 520 525

Glu Lys Arg Ala Arg Glu Lys Asn Leu
 530 535

<210> 15

<211> 1496

<212> DNA

<213> Neotyphodium lolii

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<400> 15
atgattgcga aaaatattga actcaatggc ttggatccgg caaccagggc attggacatt      60
ctatactgga aaaatcactg catcaaacag ctagaatctc tcctatgcgc cacagattca      120
tactgcactg cagacaaggc cgctcaacta cgcattttgt cagagttggt gctccccaat      180
cttggccctc ggccgtccaa tgccactggg ccatcctatc ttacacgaag tggttcccca      240
ataatgttaa gtctaaatac aacatcatca aaaaactgcg tcagatattg ctgggagatt      300
ctagggggcga ctggcgcaag taatgatgat cctttggcag tccaagttgc taaggatgta      360
gtggcttctc tgtctgctac ttttcgcctt tcaacaaaat ggagcgaaac tctactgtcc      420
aattttgcag taacaccaga ccaagctcga caagttatta acatgctacc cgagtggatt      480
caaggcttcg tacctgaggg aatggagtg c gattttccaa agagaatccc gttcgccatg      540
acatcattcg acctaaatgg ctccaatgta gctatgaagc tctacgttaa tccaagggta      600
aaggagattt taactgggtac tccctcatca gacttgggtct gggagttcct ccgaaattta      660
acaccagaaa tgaaaccacg agcggtcgac ttgcttgaga ggtaagaatg gctttgaaact      720
ttcgcccacc ttgtcagccc catacgctaa gcgctaactc cccacacatt aacaggttta      780
ttaccgataa ttcaggcccg tctgctattg agcttgtagg tattgactgc gttgacgacg      840
ctcacctatc aaatgcaagg gtcaagcttt acgttcatac catgagcagc tcatttaaca      900
ccgtaaagaa ttatgttact cttgggggtg caatctggga tgaacaaacc caaaagggct      960
taggaatact acaaagtatt tggcacctat tgcttcagga gccagagggg atttctgaca     1020
atggattcga caagcctgtg aacgactctt ccatgttatg ccaaaagcta tattttagtt     1080
tcgagctacg ccaggtaca gacttcctc aggtgaagac ctatgtgcca acttggaact     1140
atcttcgaac cgacggggaa actatccaga actatgaggc gatcttcga gcttgtgacc     1200
atccttgggg tgaagatagg acgtacggca aaatttttca agatgcattg taagttatcc     1260
cttcagatta gcgctaaaag gagtttgaga tactcctcaa tgcaagctat taggttgatga     1320
aattgccact actaattgga gctttttata gcggacctgc aaccgagagt cggaaaaaac     1380
ccattcactg cgacgcctct tttctgttta ccgaagaaac tgggtgtctac cagacgtgt      1440
atttcagtcc tccgattgag ggggaaacag aagtccagtc aaatctcgtt gcttga      1496

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<210> 16

<211> 439

<212> PRT

<213> *Neotyphodium lolii*

<400> 16

Met	Ile	Ala	Lys	Asn	Ile	Glu	Leu	Asn	Gly	Leu	Asp	Pro	Ala	Thr	Arg
1			5					10						15	

Ala Leu Asp Ile Leu Tyr Trp Lys Asn His Cys Ile Lys Gln Leu Glu
 20 25 30

Ser Leu Leu Cys Ala Thr Asp Ser Tyr Cys Thr Ala Asp Lys Ala Ala
 35 40 45

Gln Leu Arg Ile Leu Ser Glu Leu Val Leu Pro Asn Leu Gly Pro Arg
 50 55 60

Pro Ser Asn Ala Thr Gly Pro Ser Tyr Leu Thr Arg Ser Gly Ser Pro
 65 70 75 80

Ile Met Leu Ser Leu Asn Thr Thr Ser Ser Lys Asn Cys Val Arg Tyr
 85 90 95

Cys Trp Glu Ile Leu Gly Ala Thr Gly Ala Ser Asn Asp Asp Pro Leu
 100 105 110

Ala Val Gln Val Ala Lys Asp Val Val Ala Ser Leu Ser Ala Thr Phe
 115 120 125

Arg Leu Ser Thr Lys Trp Ser Glu Thr Leu Leu Ser Asn Phe Ala Val
 130 135 140

Thr Pro Asp Gln Ala Arg Gln Val Ile Asn Met Leu Pro Glu Trp Ile
 145 150 155 160

Gln Gly Phe Val Pro Glu Gly Met Glu Cys Asp Phe Pro Lys Arg Ile
 165 170 175

Pro Phe Ala Met Thr Ser Phe Asp Leu Asn Gly Ser Asn Val Ala Met
 180 185 190

Lys Leu Tyr Val Asn Pro Arg Val Lys Glu Ile Leu Thr Gly Thr Pro
 195 200 205

Ser Ser Asp Leu Val Trp Glu Phe Leu Arg Asn Leu Thr Pro Glu Met
 210 215 220

Lys Pro Arg Ala Val Asp Leu Leu Glu Arg Phe Ile Thr Asp Asn Ser
 225 230 235 240

Gly Pro Ser Ala Ile Glu Leu Val Gly Ile Asp Cys Val Asp Asp Ala
 245 250 255

His Leu Ser Asn Ala Arg Val Lys Leu Tyr Val His Thr Met Ser Ser
 260 265 270

Ser Phe Asn Thr Val Lys Asn Tyr Val Thr Leu Gly Gly Ala Ile Trp
 275 280 285

Asp Glu Gln Thr Gln Lys Gly Leu Gly Ile Leu Gln Ser Ile Trp His
 290 295 300

Leu Leu Leu Gln Glu Pro Glu Gly Ile Ser Asp Asn Gly Phe Asp Lys
 305 310 315 320

Pro Val Asn Asp Ser Ser Met Leu Cys Gln Lys Leu Tyr Phe Ser Phe
 325 330 335

Glu Leu Arg Pro Gly Thr Asp Phe Pro Gln Val Lys Thr Tyr Val Pro
 340 345 350

Thr Trp Asn Tyr Leu Arg Thr Asp Gly Glu Thr Ile Gln Asn Tyr Glu
 355 360 365

Ala Ile Phe Arg Ala Cys Asp His Pro Trp Gly Glu Asp Arg Thr Tyr
 370 375 380

Gly Lys Ile Phe Gln Asp Ala Phe Gly Pro Ala Thr Glu Ser Arg Lys
 385 390 395 400

Lys Pro Ile His Cys Asp Ala Ser Phe Leu Phe Thr Glu Glu Thr Gly
 405 410 415

Val Tyr Gln Thr Leu Tyr Phe Ser Pro Pro Ile Glu Gly Glu Thr Glu
 420 425 430

Val Gln Ser Asn Leu Val Ala
 435

<210> 17
 <211> 1110
 <212> DNA
 <213> *Epichloe festucae*

<400> 17
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 ccaagtctag tctactgcaa tggtaacatt gcgagagacgt atctcgaaga aaaggtatth 120
 atactgctcc ttataatct cgaatgccac ttaaaattta gacaggthtt gacagcgccg 180
 ttggattatt tgcgtgcctt acctagcaaa gatattcgca gtggactgac cgacgccatt 240
 aatgagttcc tgcgtgtccc agaggaaaag gttcttgtca taaagcgtat aattgatctt 300
 cttcacaatg catccttact gtaagttcga gattgcataa catagacctg gtagattcta 360
 actaacagct ttagcattga tgatatccag gattcatcta aactgcgacg tggagtcctt 420

gtagccacc acatatttgg aatcgacaaa acaataaatt cggccaatct agcgtatttc 480
 attgcccaga gagagcttga gaagcttacg aatcctcgag catttgctat atataatgag 540
 gagctaataca atctgcatcg tggtcagggt atggagctcc attggagaga atcgctccat 600
 tgcctaccg aagatgagta tctgcgaatg atccaaaaga agacaggcgg tctgttccga 660
 ttggcaatca gactgctgca aggcgaaagc gctagcgatg acgattatgt ctcaattatt 720
 gatactctcg gaacctgtt ccagattcga gatgactatc aaaacttaca gagtgatata 780
 tattctaaga acaaaggcta ctgtgaggat ttaacagagg gcaaattctc gtatccggtc 840
 atccatagta ttcggtcgag accaggagat gttcgattaa tcaatatttt gaaacagcgt 900
 agtgaagatg ttatggtgaa gcaatacgcg gtgcaacata tcgaatctac aggaagcttc 960
 gcattctgtc aaaataaaat tcaatctttg gtggagcaag caagagagca attggcggct 1020
 ctagaaaata gcagttcatg tggaggcccc gttcgcgaca tccttgacaa gttagcaata 1080
 aaaccacggg caaatataga agtagagtag 1110

<210> 18
 <211> 334
 <212> PRT
 <213> *Epichloe festucae*

<400> 18

Met Thr Met Ala Ala Asn Asp Phe Pro Phe Gln Cys Gln Glu Lys Lys
1 5 10 15

Ser Tyr Ser Gln Pro Ser Leu Val Tyr Cys Asn Gly Asn Ile Ala Glu
20 25 30

Thr Tyr Leu Glu Glu Lys Val Leu Thr Ala Pro Leu Asp Tyr Leu Arg
35 40 45

Ala Leu Pro Ser Lys Asp Ile Arg Ser Gly Leu Thr Asp Ala Ile Asn
50 55 60

Glu Phe Leu Arg Val Pro Glu Glu Lys Val Leu Val Ile Lys Arg Ile
65 70 75 80

Ile Asp Leu Leu His Asn Ala Ser Leu Leu Ile Asp Asp Ile Gln Asp
85 90 95

Ser Ser Lys Leu Arg Arg Gly Val Pro Val Ala His His Ile Phe Gly
100 105 110

Ile Ala Gln Thr Ile Asn Ser Ala Asn Leu Ala Tyr Phe Ile Ala Gln
115 120 125

Arg Glu Leu Glu Lys Leu Thr Asn Pro Arg Ala Phe Ala Ile Tyr Asn
 130 135 140

Glu Glu Leu Ile Asn Leu His Arg Gly Gln Gly Met Glu Leu His Trp
 145 150 155 160

Arg Glu Ser Leu His Cys Pro Thr Glu Asp Glu Tyr Leu Arg Met Ile
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Gln Lys Lys Thr Gly Gly Leu Phe Arg Leu Ala Ile Arg Leu Leu Gln
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Gly Glu Ser Ala Ser Asp Asp Asp Tyr Val Ser Leu Ile Asp Thr Leu
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Gly Thr Leu Phe Gln Ile Arg Asp Asp Tyr Gln Asn Leu Gln Ser Asp
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Ile Tyr Ser Lys Asn Lys Gly Tyr Cys Glu Asp Leu Thr Glu Gly Lys
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Phe Ser Tyr Pro Val Ile His Ser Ile Arg Ser Arg Pro Gly Asp Val
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Arg Leu Ile Asn Ile Leu Lys Gln Arg Ser Glu Asp Val Met Val Lys
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Gln Tyr Ala Val Gln His Ile Glu Ser Thr Gly Ser Phe Ala Phe Cys
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Gln Asn Lys Ile, Gln Ser Leu Val Glu Gln Ala Arg Glu Gln Leu Ala
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 <213> *Epichloe festucae*

<400> 20

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Ser Ile Glu Asp Glu Ile Glu Pro Leu Glu Ser Ala Met Met Arg Tyr
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Ser Phe Gly Tyr Pro Val Ala Phe Leu Glu Arg Gln Arg Phe Leu Gln
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Ser Asp Gly Ala Lys Tyr Leu Ala Asp Ile Val Ile Gly Ala Asp Gly
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Ser Gln Ile Ser Val Leu Glu Ala Pro Asn Ala Ser Ile Lys His Asp
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Tyr Ser Cys Ile Tyr Gly Ile Ser Leu Asn Val Pro Gln Ile Ile Leu
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Gly Ile Gln Leu Asn Cys Leu Asp Asp Gly Val Ser Ile His Leu Phe
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Glu Phe Ser Met Ala Gln Arg Ala Arg Thr Glu Ser Val Cys Ala Gln
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 <213> *Epichloe festucae*

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 <213> *Epichloe festucae*

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His	Phe	Gly	Tyr	Gly	Thr	Trp	Ala	Cys	Pro	Gly	Arg	Phe	Leu	Ala	Ser
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485

490

495

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